SIMULATION ANALYSIS OF AN IMPROVED DESIGN FOR TEMPORARY CRASH BARRIER USING PLASTIC RECYCLE MATERIAL

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To my beloved mother **Sarah Binti Abdul Manaf**

To my beloved wife **Mizan Musfirah Binti Mustapha**

To my beloved princess **Nur Syauqina Mawaddah**

To my beloved princess **Nur Syauqina Mardhiyya**

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ABSTRACT

Plastic temporary barrier acts as a road safety device for protecting or minimizing the risk of workers exposed to traffic flows as well as minimizing the risk of injury to vehicle occupants in the event of collision. Plastic temporary barrier is one of road safety device application which capable of absorbing the impact energy during collision with errant vehicles, thus minimize the severity of injury upon impact. Currently, all plastic temporary barriers were developed using Virgin High Density Polyethylene (V-HDPE) material. Currently, most of production defect and destruction temporary barrier will be scrapping which mean contributes into plastic waste. Therefore, releasing on this situation, by implementing plastic recycle material as alternative to control the plastic waste. Comprehending on this situation; the study was conducted to identify the potential of using Recycled High Density Polyethylene (R-HDPE) for road safety barrier application through make an improvement design based on selected temporary barrier which have better energy absorption and complies with road safety regulation.

In order to analyze the energy absorption capability of the recycled plastic, a finite element method using Abaqus/Explicit was used to simulate a car impacting a series of assembled temporary barrier at 90˚ and 20 ˚degrees angle following the Test Level 0 (TL-0) of standard impact test regulation. Three types of conceptual designs of the temporary barrier were proposed to improve the current barrier design. The capabilities of all the barrier designs in terms of their internal energy, kinetic energy, total energy, stress and displacement were analyzed. The tests were conducted using both plastic material properties of primary recycle R-HDPE and V-HDPE from. The

output results of both materials were compared to distinguish whether R-HDPE can provide acceptable absorption capability as compared to V-HDPE. Overall results showed a similar pattern of R-HDPE and V-HDPE materials in terms of energy absorption regardless of any types of barrier design. However, Conceptual Design 2 (CD2) based on R-HDPE material that includes external ribs along the outer structure of the barrier provides better energy absorption compared to the other two of barrier designs. These show that the improvement design provide an influence to the ability of R-HDPE as temporary barrier.

In conclusion, analysis of the simulated results on the primary recycled R-HDPE temporary barrier showed a good potential of how this material can be an alternative as a road safety device material. With the use of such recycled materials, the amount of plastic waste can be controlled as well as supporting sustainable manufacturing environment.

ABSTRAK

Halangan sementara plastik bertindak sebagai alat keselamatan jalan raya untuk melindungi atau mengurangkan risiko pekerja terdedah kepada aliran trafik serta mengurangkan risiko kecederaan kepada penghuni kenderaan sekiranya berlaku perlanggaran. Halangan sementara plastik adalah salah satu peranti keselamatan jalan raya permohonan yang boleh menyerap tenaga kesan semasa perlanggaran dengan kenderaan ingkar, sekali gus mengurangkan keterukan kecederaan apabila kesan. Pada masa ini, semua halangan sementara plastik dibangunkan menggunakan bahan baru 'High Density Polyethylene (V-HDPE)' yang ketara. Pada masa ini, kebanyakan kecacatan pengeluaran dan kemusnahan halangan sementara akan pelupusan yang bererti menyumbang ke dalam sisa plastik. Oleh itu, melepaskan kepada keadaan ini, dengan melaksanakan bahan kitar semula plastik sebagai alternatif untuk mengawal sisa plastik. Memahami keadaan ini; kajian ini dijalankan untuk mengenal pasti potensi menggunakan dikitar semula 'High Density Polyethylene (R-HDPE)' untuk keselamatan jalan raya melalui permohonan halangan membuat reka bentuk penambahbaikan berdasarkan halangan sementara dipilih yang mempunyai penyerapan tenaga yang lebih baik dan mematuhi peraturan keselamatan jalan raya.

Untuk menganalisis keupayaan penyerapan tenaga plastik dikitar semula, kaedah unsur terhingga menggunakan Abaqus/Explicit telah digunakan untuk mensimulasikan sebuah kereta yang memberi kesan satu siri halangan sementara dipasang pada 90 ˚ dan 20 ˚ darjah sudut berikut Ujian Level 0 (TL-0) standard peraturan ujian kesan. Tiga jenis reka bentuk konsep halangan sementara telah

dicadangkan untuk meningkatkan reka bentuk halangan semasa. Keupayaan semua reka bentuk halangan dari segi tenaga mereka dalaman, tenaga kinetik, jumlah tenaga, tekanan dan anjakan telah dianalisis. Ujian telah dijalankan menggunakan kedua-dua sifat bahan plastik kitar semula utama R-HDPE dan V-HDPE dari. Keputusan pengeluaran kedua-dua bahan dibandingkan untuk membezakan sama ada 'R-HDPE' boleh menyediakan keupayaan penyerapan boleh diterima berbanding dengan 'V-HDPE'. Keputusan keseluruhan menunjukkan corak yang sama iaitu 'R-HDPE' dan 'V-HDPE' bahan dari segi penyerapan tenaga tanpa mengira apa-apa jenis reka bentuk halangan. Walau bagaimanapun, Rekabentuk Konseptual 2 (CD2) berdasarkan bahan R-HDPE yang termasuk tulang rusuk luar bersama-sama struktur luar halangan menyediakan penyerapan tenaga yang lebih baik berbanding dua yang lain reka bentuk halangan. Ini menunjukkan bahawa penambahbaikkan reka bentuk memberi pengaruh kepada keupayaan R-HDPE sebagai penghalang sementara.

Kesimpulannya, analisis keputusan simulasi di kitar semula 'R-HDPE' halangan sementara yang utama menunjukkan potensi yang baik bagaimana bahan ini boleh menjadi alternatif sebagai bahan peranti keselamatan jalan raya. Dengan menggunakan bahan-bahan kitar semula itu, jumlah sisa plastik boleh dikawal dan juga menyokong persekitaran pembuatan mampan.